

Table 1. Acute Toxicity of Copper to Freshwater Animals

Species ^a	Organism Age, Size, or Lifestage	Method ^b	Chemical ^c	Reported LC50 or EC50 (total µg/L) ^d	Reported LC50 or EC50 (Diss. µg/L) ^e	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L) ^f	Species Mean Acute Value (µg/L) ^g	Reference
Worm, <i>Lumbriculus variegata</i>	adult (mixed age)	S,M,T	N	130	---	LUVA01S	37.81	48.41	Schubauer-Berigan et al. 1993
	adult (mixed age)	S,M,T	N	270	---	LUVA02S	55.39		Schubauer-Berigan et al. 1993
	adult (mixed age)	S,M,T	N	500	---	LUVA03S	54.18		Schubauer-Berigan et al. 1993
Snail, <i>Campeloma</i>	1.1-2.7 cm	F,M,T	S	2000	---	CADE01F	4319	3573	Arthur and Leonard 1970
	1.1-2.7 cm	F,M,T	S	1400	---	CADE02F	2956		Arthur and Leonard 1970
Snail, <i>Juga plicifera</i>	adult	F,M,T	C	15	---	JUPL01F	12.31	12.31	Nebeker et al. 1986b
Snail, <i>Lithoglyphus virens</i>	adult	F,M,T	C	8	---	LIVI01F	6.67	6.67	Nebeker et al. 1986b
Snail, <i>Physa integra</i>	0.4-0.7 cm	F,M,T	S	41	---	PHIN01F	21.81	20.41	Arthur and Leonard 1970
	0.4-0.7 cm	F,M,T	S	37	---	PHIN02F	19.09		Arthur and Leonard 1970
Freshwater mussel, <i>Actinonaias</i>	juvenile	S,M,T	S	27	---	ACPE01S	10.36	11.33	Keller unpublished
	juvenile	S,M,T	S	<29	---	ACPE02S	12.39		Keller unpublished
Freshwater mussel, <i>Utterbackia imbecilli</i>	1-2 d juv	S,M,T	S	86	---	UTIM01S	177.9	52.51	Keller and Zam 1991
	1-2 d juv	S,M,T	S	199	---	UTIM02S	172.3		Keller and Zam 1991
	juvenile	S,M,T	N	76	---	UTIM03S	40.96		Keller unpublished
	juvenile	S,M,T	N	85	---	UTIM04S	43.22		Keller unpublished
	juvenile	S,M,T	N	41	---	UTIM05S	24.12		Keller unpublished
	juvenile	S,M,T	S	79	---	UTIM06S	39.04		Keller unpublished
	juvenile	S,M,T	S	72	---	UTIM07S	39.96		Keller unpublished
	juvenile	S,M,T	S	38	---	UTIM08S	28.31		Keller unpublished
Cladoceran, <i>Ceriodaphnia dubia</i>	<4 h	S,M,T	C	19	---	CEDU01S	10.28	5.93	Carlson et al. 1986
	<4 h	S,M,T	C	17	---	CEDU02S	9.19		Carlson et al. 1986
	<12 h	S,M,D	---	-	25	CEDU03S	7.98		Belanger et al. 1989
	<12 h	S,M,D	---	-	17	CEDU04S	5.25		Belanger et al. 1989
	<12 h	S,M,D	---	-	30	CEDU05S	9.80		Belanger et al. 1989
	<12 h	S,M,D	---	-	24	CEDU06S	7.63		Belanger et al. 1989
	<12 h	S,M,D	---	-	28	CEDU07S	9.06		Belanger et al. 1989
	<12 h	S,M,D	---	-	32	CEDU08S	10.56		Belanger et al. 1989
	<12 h	S,M,D	---	-	23	CEDU09S	7.28		Belanger et al. 1989
	<12 h	S,M,D	---	-	20	CEDU10S	6.25		Belanger et al. 1989
	<12 h	S,M,D	---	-	19	CEDU11S	5.91		Belanger et al. 1989
	<12 h	S,M,D	---	-	26	CEDU12S	3.10		Belanger et al. 1989
	<12 h	S,M,D	---	-	21	CEDU13S	2.46		Belanger et al. 1989
	<12 h	S,M,D	---	-	27	CEDU14S	3.24		Belanger et al. 1989
	<12 h	S,M,D	---	-	37	CEDU15S	4.66		Belanger et al. 1989
	<12 h	S,M,D	---	-	34	CEDU16S	4.22		Belanger et al. 1989
	<12 h	S,M,D	---	-	67	CEDU17S	5.50		Belanger et al. 1989
	<12 h	S,M,D	---	-	38	CEDU18S	2.72		Belanger et al. 1989
	<12 h	S,M,D	---	-	78	CEDU19S	6.74		Belanger et al. 1989
	<12 h	S,M,D	---	-	81	CEDU20S	7.10		Belanger et al. 1989
	<12 h	S,M,D	---	-	28	CEDU21S	4.10		Belanger and Cherry 1990

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	<12 h	S,M,D	---	-	84	CEDU22S	10.74		Belanger and Cherry 1990
	<12 h	S,M,T	S	13.4	---	CEDU23S	6.19		Oris et al. 1991
	<24 h	R,M,T,D	S	6.98	5.54	CEDU24R	5.03		Diamond et al. 1997b
Cladoceran, <i>Daphnia magna</i>	1 d	S,M,T	C	9.1	---	DAMA01S	3.42	6.00	Nebeker et al. 1986a
	1 d	S,M,T	C	11.7	---	DAMA02S	4.43		Nebeker et al. 1986a
	<2 h	S,M,T	C	6.6	---	DAMA03S	2.50		Nebeker et al. 1986a
	<2 h	S,M,T	C	9.9	---	DAMA04S	3.78		Nebeker et al. 1986a
	1 d	S,M,T	C	11.7	---	DAMA05S	13.46		Nebeker et al. 1986a
	<4 h	S,M,T	C	6.7	---	DAMA06S	8.21		Nebeker et al. 1986a
	1 d	S,M,T	C	9.1	---	DAMA07S	4.40		Nebeker et al. 1986a
	<2 h	S,M,T	C	5.2	---	DAMA08S	2.16		Nebeker et al. 1986a
	<24 h	S,M,T	S	41.2	---	DAMA09S	21.55		Baird et al. 1991
	<24 h	S,M,T	S	10.5	---	DAMA10S	5.63		Baird et al. 1991
	<24 h	S,M,T	S	20.6	---	DAMA11S	11.31		Baird et al. 1991
	<24 h	S,M,T	S	17.3	---	DAMA12S	9.48		Baird et al. 1991
	<24 h	S,M,T	S	70.7	---	DAMA13S	33.58		Baird et al. 1991
	<24 h	S,M,T	S	31.3	---	DAMA14S	16.90		Baird et al. 1991
	<24 h	S,M,I	S	7.1	---	DAMA15S	2.67		Meador 1991
	<24 h	S,M,I	S	16.4	---	DAMA16S	4.26		Meador 1991
	<24 h	S,M,I	S	39.9	---	DAMA17S	5.18		Meador 1991
	<24 h	S,M,I	S	18.7	---	DAMA18S	3.39		Meador 1991
	<24 h	S,M,I	S	18.9	---	DAMA19S	1.99		Meador 1991
	<24 h	S,M,I	S	39.7	---	DAMA20S	3.04		Meador 1991
	<24 h	S,M,I	S	46	---	DAMA21S	8.93		Meador 1991
	<24 h	S,M,I	S	71.9	---	DAMA22S	9.97		Meador 1991
	<24 h	S,M,I	S	57.2	---	DAMA23S	5.76		Meador 1991
	<24 h	S,M,I	S	67.8	---	DAMA24S	4.16		Meador 1991
	<24 h	S,M,T	C	26	---	DAMA25S	10.34		Chapman et al. Manuscript
	<24 h	S,M,T	C	30	---	DAMA26S	9.04		Chapman et al. Manuscript
	<24 h	S,M,T	C	38	---	DAMA27S	9.84		Chapman et al. Manuscript
	<24 h	S,M,T	C	69	---	DAMA28S	12.31		Chapman et al. Manuscript
	<24 h	S,M,T,D	S	4.8	---	DAMA29S	1.22		Long's MS Thesis
	<24 h	S,M,T,D	S	7.4	---	DAMA30S	16.29		Long's MS Thesis
	<24 h	S,M,T,D	S	6.5	---	DAMA31S	2.11		Long's MS Thesis
Cladoceran, <i>Daphnia pulicaria</i>	---	S,M,T	S	11.4	---	DAPC01S	1.63	2.73	Lind et al. Manuscript (1978)
	---	S,M,T	S	9.06	---	DAPC02S	1.04		Lind et al. Manuscript (1978)
	---	S,M,T	S	7.24	---	DAPC03S	0.88		Lind et al. Manuscript (1978)
	---	S,M,T	S	10.8	---	DAPC04S	1.13		Lind et al. Manuscript (1978)
	---	S,M,T	S	55.4	---	DAPC05S	8.81		Lind et al. Manuscript (1978)
	---	S,M,T	S	55.3	---	DAPC06S	6.03		Lind et al. Manuscript (1978)
	---	S,M,T	S	53.3	---	DAPC07S	4.12		Lind et al. Manuscript (1978)
	---	S,M,T	S	97.2	---	DAPC08S	3.94		Lind et al. Manuscript (1978)

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	---	S,M,T	S	199	---	DAPC09S	3.01		Lind et al. Manuscript (1978)
	---	S,M,T	S	213	---	DAPC10S	7.63		Lind et al. Manuscript (1978)
	---	S,M,T	S	165	---	DAPC11S	5.78		Lind et al. Manuscript (1978)
	---	S,M,T	S	35.5	---	DAPC12S	1.83		Lind et al. Manuscript (1978)
	---	S,M,T	S	78.8	---	DAPC13S	2.36		Lind et al. Manuscript (1978)
	---	S,M,T	S	113	---	DAPC14S	1.06		Lind et al. Manuscript (1978)
	---	S,M,T	S	76.4	---	DAPC15S	2.36		Lind et al. Manuscript (1978)
	---	S,M,T	S	84.7	---	DAPC16S	6.62		Lind et al. Manuscript (1978)
	---	S,M,T	S	184	---	DAPC17S	7.14		Lind et al. Manuscript (1978)
	---	S,M,T	S	9.3	---	DAPC18S	1.11		Lind et al. Manuscript (1978)
	---	S,M,T	S	17.8	---	DAPC19S	2.11		Lind et al. Manuscript (1978)
	---	S,M,T	S	23.7	---	DAPC20S	2.67		Lind et al. Manuscript (1978)
	---	S,M,T	S	27.3	---	DAPC21S	2.77		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.2	---	DAPC22S	2.81		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.1	---	DAPC23S	2.60		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.1	---	DAPC24S	2.31		Lind et al. Manuscript (1978)
Cladoceran, <i>Scapholeberis</i> sp.	adult	S,M,T	C	18	---	SCSP01S	9.73	9.73	Carlson et al. 1986
Amphipod, <i>Gammarus</i>	1-3 d 1-3 d	F,M,T F,M,T	S S	22 19	---	GAPS01F GAPS02F	10.39 8.86	9.60	Arthur and Leonard 1970 Arthur and Leonard 1970
Amphipod, <i>Hyalella azteca</i>	7-14 d 7-14 d 7-14 d <7 d <7 d <7 d <7 d	S,M,T S,M,T S,M,T S,M,T S,M,T S,M,T S,M,T	N N N S S S S	17 24 87 24.3 23.8 8.2 10	---	HYAZ01S HYAZ02S HYAZ03S HYAZ04S HYAZ05S HYAZ06S HYAZ07S	12.19 9.96 15.77 8.26 8.09 15.49 18.80	12.07	Schubauer-Berigan et al. 1993 Schubauer-Berigan et al. 1993 Schubauer-Berigan et al. 1993 Welsh 1996 Welsh 1996 Welsh 1996 Welsh 1996
Stonefly, <i>Acroneuria lycorias</i>	---	S,M,T	S	8300	---	ACLY01S	20636	20636	Warnick and Bell 1969
Midge, <i>Chironomus</i>	4th instar	S,M,T	S	739	---	CHDE01S	1987	1987	Kosalwat and Knight 1987
Shovelnose sturgeon, <i>Scaphirhynchus</i>	fry, 6.01 cm, 0.719 g	S,M,T	S	160	---	SCPL01S	69.63	69.63	Dwyer et al. 1999
Apache trout, <i>Oncorhynchus</i>	larval, 0.38 g	S,M,T	S	70	---	ONAP01S	32.54	32.54	Dwyer et al. 1995
Lahontan cutthroat <i>Oncorhynchus</i> <i>clarkii henshawi</i>	larval, 0.34 g larval, 0.57 g	S,M,T S,M,T	S S	80 60	---	ONCL01S ONCL02S	34.26 24.73	32.97	Dwyer et al. 1995 Dwyer et al. 1995

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Cutthroat trout, <i>Oncorhynchus clarkii</i>	7.4 cm, 4.2 g	F,M,T,D	C	398.91	367	ONCL03F	67.30		Chakoumakos et al. 1979
	6.9 cm, 3.2 g	F,M,T,D	C	197.87	186	ONCL04F	44.91		Chakoumakos et al. 1979
	8.8 cm, 9.7 g	F,M,T,D	C	41.35	36.8	ONCL05F	21.87		Chakoumakos et al. 1979
	8.1 cm, 4.4 g	F,M,T,D	C	282.93	232	ONCL06F	51.94		Chakoumakos et al. 1979
	6.8 cm, 2.7 g	F,M,T,D	C	186.21	162	ONCL07F	111.3		Chakoumakos et al. 1979
	7.0 cm, 3.2 g	F,M,T,D	C	85.58	73.6	ONCL08F	39.53		Chakoumakos et al. 1979
	8.5 cm, 5.2 g	F,M,T,D	C	116.67	91	ONCL09F	19.63		Chakoumakos et al. 1979
	7.7 cm, 4.4 g	F,M,T,D	C	56.20	44.4	ONCL10F	18.81		Chakoumakos et al. 1979
	8.9 cm, 5.7 g	F,M,T,D	C	21.22	15.7	ONCL11F	10.60		Chakoumakos et al. 1979
Pink salmon, <i>Oncorhynchus gorbuscha</i>	alevin (newly hatched)	F,M,T	S	143	---	ONGO01F	41.65	40.13	Servizi and Martens 1978
	alevin	F,M,T	S	87	---	ONGO02F	19.70		Servizi and Martens 1978
	fry	F,M,T	S	199	---	ONGO03F	78.76		Servizi and Martens 1978
Coho salmon, <i>Oncorhynchus kisutch</i>	6 g	R,M,T,I	---	164	---	ONKI01R	106.09	22.93	Buckley 1983
	parr	F,M,T	C	33	---	ONKI02F	20.94		Chapman 1975
	adult, 2.7 kg	F,M,T	C	46	---	ONKI03F	32.66		Chapman and Stevens 1978
	fry	F,M,T,D,I	---	61	49	ONKI04F	12.67		Mudge et al. 1993
	smolt	F,M,T,D,I	---	63	51	ONKI05F	13.19		Mudge et al. 1993
	fry	F,M,T,D,I	---	86	58	ONKI06F	11.95		Mudge et al. 1993
	parr	F,M,T,D,I	---	103	78	ONKI07F	22.98		Mudge et al. 1993
Rainbow trout, <i>Oncorhynchus mykiss</i>	larval, 0.67 g	S,M,T	S	110	---	ONMY01S	41.64	22.19	Dwyer et al. 1995
	larval, 0.48 g	S,M,T	S	50	---	ONMY02S	25.26		Dwyer et al. 1995
	larval, 0.50 g	S,M,T	S	60	---	ONMY03S	29.46		Dwyer et al. 1995
	swim-up, 0.25 g	R,M,T,D	C	46.7	40	ONMY04R	10.90		Cacela et al. 1996
	swim-up, 0.25 g	R,M,T,D	C	24.2	19	ONMY05R	9.04		Cacela et al. 1996
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	3.4	ONMY06R	5.02		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	8.1	ONMY07R	11.97		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	17.2	ONMY08R	13.80		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	32	ONMY09R	23.84		Welsh et al. 2000
	alevin	F,M,T	C	28	---	ONMY10F	20.30		Chapman 1975, 1978
	swim-up, 0.17 g	F,M,T	C	17	---	ONMY11F	12.54		Chapman 1975, 1978
	parr, 8.6 cm, 6.96 g	F,M,T	C	18	---	ONMY12F	9.87		Chapman 1975, 1978
	smolt, 18.8 cm, 68.19	F,M,T	C	29	---	ONMY13F	22.48		Chapman 1975, 1978
	1 g	F,M,T,D	C	-	169	ONMY14F	23.41		Chakoumakos et al. 1979
	4.9 cm	F,M,T,D	C	-	85.3	ONMY15F	10.20		Chakoumakos et al. 1979
	6.0 cm, 2.1 g	F,M,T,D	C	-	83.3	ONMY16F	9.93		Chakoumakos et al. 1979
	6.1 cm, 2.5 g	F,M,T,D	C	-	103	ONMY17F	12.71		Chakoumakos et al. 1979
	2.6 g	F,M,T,D	C	-	274	ONMY18F	44.54		Chakoumakos et al. 1979
	4.3 g	F,M,T,D	C	-	128	ONMY19F	16.51		Chakoumakos et al. 1979
	9.2 cm, 9.4 g	F,M,T,D	C	-	221	ONMY20F	33.33		Chakoumakos et al. 1979
	9.9 cm, 11.5 g	F,M,T,D	C	-	165	ONMY21F	22.70		Chakoumakos et al. 1979
	11.8 cm, 18.7 g	F,M,T,D	C	-	197	ONMY22F	28.60		Chakoumakos et al. 1979
	13.5 cm, 24.9 g	F,M,T,D	C	-	514	ONMY23F	99.97		Chakoumakos et al. 1979

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	13.4 cm, 25.6 g	F,M,T,D	C	-	243	ONMY24F	37.88		Chakoumakos et al. 1979
	6.7 cm, 2.65 g	F,M,T	C	2.8	---	ONMY25F	7.00		Cusimano et al. 1986
	parr	F,M,T,D,I	--	90	68	ONMY26F	19.73		Mudge et al. 1993
	swim-up, 0.29 g	F,M,T,D	C	19.6	18	ONMY27F	8.10		Cacela et al. 1996
	swim-up, 0.25 g	F,M,T,D	C	12.9	12	ONMY28F	32.15		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	5.9	5.7	ONMY29F	24.80		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	37.8	35	ONMY30F	16.16		Cacela et al. 1996
	swim-up, 0.26 g	F,M,T,D	C	25.1	18	ONMY31F	37.66		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	17.2	17	ONMY32F	24.19		Cacela et al. 1996
	0.64 g, 4.1 cm	F,M,T,D	C	101	---	ONMY33F	39.73		Hansen et al. 2000
	0.35 g, 3.4 cm	F,M,T,D	C	308	---	ONMY34F	85.83		Hansen et al. 2000
	0.68 g, 4.2 cm	F,M,T,D	C	93	---	ONMY35F	95.9		Hansen et al. 2000
	0.43 g, 3.7 cm	F,M,T,D	C	35.9	---	ONMY36F	50.83		Hansen et al. 2000
	0.29 g, 3.4 cm	F,M,T,D	C	54.4	---	ONMY37F	47.69		Hansen et al. 2000
Sockeye salmon, <i>Oncorhynchus nerka</i>	alevin (newly hatched)	F,M,T	S	190	---	ONNE01F	71.73	54.82	Servizi and Martens 1978
	alevin	F,M,T	S	200	---	ONNE02F	79.52		Servizi and Martens 1978
	alevin	F,M,T	S	100	---	ONNE03F	23.74		Servizi and Martens 1978
	alevin	F,M,T	S	110	---	ONNE04F	27.22		Servizi and Martens 1978
	alevin	F,M,T	S	130	---	ONNE05F	35.36		Servizi and Martens 1978
	fry	F,M,T	S	150	---	ONNE06F	45.37		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	210	---	ONNE07F	87.77		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	170	---	ONNE08F	57.53		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	190	---	ONNE09F	71.73		Servizi and Martens 1978
	smolt, 4.8 g	F,M,T	S	240	---	ONNE10F	114.4		Servizi and Martens 1978
Chinook salmon, <i>Oncorhynchus tshawytscha</i>	alevin, 0.05 g	F,M,T	C	26	---	ONTS01F	14.48	25.02	Chapman 1975, 1978
	swim-up, 0.23 g	F,M,T	C	19	---	ONTS02F	10.44		Chapman 1975, 1978
	parr, 9.6 cm, 11.58 g	F,M,T	C	38	---	ONTS03F	28.30		Chapman 1975, 1978
	smolt, 14.4 cm, 32.46	F,M,T	C	26	---	ONTS04F	20.09		Chapman 1975, 1978
	3 mo, 1.35 g	F,M,T,I	C	10.2	---	ONTS05F	19.41		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	24.1	---	ONTS06F	30.91		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	82.5	---	ONTS07F	32.74		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	128.4	---	ONTS08F	20.66		Chapman and McCrady 1977
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	7.4	ONTS09F	36.49		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	12.5	ONTS10F	30.85		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	14.3	ONTS11F	31.49		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	18.3	ONTS12F	48.56		Welsh et al. 2000

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Bull trout, <i>Salvelinus confluent</i>	0.130 g, 2.6 cm	F,M,T,D	C	228	---	SACO01F	69.70	68.31	Hansen et al. 2000
	0.555 g, 4.0 cm	F,M,T,D	C	207	---	SACO02F	63.62		Hansen et al. 2000
	0.774 g, 4.5 cm	F,M,T,D	C	66.6	---	SACO03F	74.18		Hansen et al. 2000
	1.520 g, 5.6 cm	F,M,T,D	C	50	---	SACO04F	63.60		Hansen et al. 2000
	1.160 g, 5.2 cm	F,M,T,D	C	89	---	SACO05F	71.11		Hansen et al. 2000
Chiselmouth, <i>Acrocheilus</i>	4.6 cm, 1.25 g	F,M,T	C	143	---	ACAL01F	216.3	216.3	Andros and Garton 1980
Bonytail chub, <i>Gila elegans</i>	larval, 0.29 g	S,M,T	S	200	---	GIEL01S	63.22	63.22	Dwyer et al. 1995
Golden shiner, <i>Notemigonus crysoleucas</i>	---	F,M,T	C	84600	---	NOCR01F	107860	107860	Hartwell et al. 1989
Fathead minnow, <i>Pimephales promelas</i>	adult, 40 mm	S,M,T	S	310	---	PIPR01S	266.3	69.63	Birge et al. 1983
	adult, 40 mm	S,M,T	S	120	---	PIPR02S	105.61		Birge et al. 1983
	adult, 40 mm	S,M,T	S	390	---	PIPR03S	207.3		Birge et al. 1983; Benson & Birge
	---	S,M,T	C	55	---	PIPR04S	38.08		Carlson et al. 1986
	---	S,M,T	C	85	---	PIPR05S	70.71		Carlson et al. 1986
	<24 h	S,M,T	N	15	---	PIPR06S	11.23		Schubauer-Berigan et al. 1993
	<24 h	S,M,T	N	44	---	PIPR07S	18.03		Schubauer-Berigan et al. 1993
	<24 h	S,M,T	N	>200	---	PIPR08S	24.38		Schubauer-Berigan et al. 1993
	<24 h, 0.68 mg	S,M,T	S	4.82	---	PIPR09S	8.87		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	8.2	---	PIPR10S	16.72		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	31.57	---	PIPR11S	25.15		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	21.06	---	PIPR12S	17.67		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	35.97	---	PIPR13S	21.24		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	59.83	---	PIPR14S	16.64		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	4.83	---	PIPR15S	5.92		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	70.28	---	PIPR16S	13.34		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	83.59	---	PIPR17S	8.22		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	182	---	PIPR18S	13.91		Welsh et al. 1993
	larval, 0.32 g	S,M,T	S	290	---	PIPR19S	73.92		Dwyer et al. 1995
	larval, 0.56 g	S,M,T	S	630	---	PIPR20S	157.9		Dwyer et al. 1995
	larval, 0.45 g	S,M,T	S	400	---	PIPR21S	103.2		Dwyer et al. 1995
	larval, 0.39 g	S,M,T	S	390	---	PIPR22S	161.7		Dwyer et al. 1995
	3.2-5.5 cm, 0.42-3.23	S,M,T	S	450	---	PIPR23S	152.9		Richards and Beitingen 1995
	2.8-5.1 cm, 0.30-2.38	S,M,T	S	297	---	PIPR24S	77.75		Richards and Beitingen 1995
	1.9-4.6 cm, 0.13-1.55	S,M,T	S	311	---	PIPR25S	67.56		Richards and Beitingen 1995
	3.0-4.8 cm, 0.23-1.36	S,M,T	S	513	---	PIPR26S	76.36		Richards and Beitingen 1995
	<24 h	S,M,T,D	S	62.23	53.96	PIPR27S	25.70		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	165.18	PIPR28S	87.89		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	68.58	59.46	PIPR29S	28.59		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	168.91	146.46	PIPR30S	89.18		Erickson et al. 1996a,b

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	<24 h	S,M,T,D	S	94.62	82.04	PIPR31S	49.27		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	143.51	124.43	PIPR32S	104.90		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	120.65	103.76	PIPR33S	86.54		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	167.32	PIPR34S	122.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	133.35	120.02	PIPR35S	75.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	184.15	169.42	PIPR36S	122.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	304.8	268.22	PIPR37S	78.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	292.1	242.44	PIPR38S	201.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	133.35	113.35	PIPR39S	100.75		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.71	77.88	PIPR40S	72.95		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	128.02	PIPR41S	112.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	177.8	151.13	PIPR42S	136.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	166.62	PIPR43S	136.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	163.83	PIPR44S	147.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	157.48	PIPR45S	125.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	234.95	199.71	PIPR46S	157.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	128.52	PIPR47S	127.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	171.45	150.88	PIPR48S	153.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	131.06	PIPR49S	114.57		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	184.15	160.21	PIPR50S	131.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	182.88	PIPR51S	130.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	180.85	PIPR52S	105.76		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	176.78	PIPR53S	128.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	222.25	188.91	PIPR54S	122.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	125.60	PIPR55S	111.87		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.7	117.35	PIPR56S	85.45		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.7	114.55	PIPR57S	83.10		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	126.49	PIPR58S	85.82		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	172.72	PIPR59S	110.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	167.32	PIPR60S	106.46		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	266.7	226.70	PIPR61S	133.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	99.06	84.20	PIPR62S	138.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	111.13	97.79	PIPR63S	165.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	78.74	70.08	PIPR64S	114.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.71	81.58	PIPR65S	121.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	85.09	77.43	PIPR66S	106.69		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	123.19	110.87	PIPR67S	124.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.1	151.89	PIPR68S	114.24		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	175.26	PIPR69S	89.93		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.1	145.29	PIPR70S	140.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	127	111.76	PIPR71S	100.16		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.08	79.18	PIPR72S	58.74		Erickson et al. 1996a,b

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	<24 h	S,M,T,D	S	66.68	60.01	PIPR73S	37.67		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	393.70	370.08	PIPR74S	163.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	317.50	292.10	PIPR75S	252.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	107.95	101.47	PIPR76S	169.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	67.95	62.51	PIPR77S	146.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	45.72	42.06	PIPR78S	126.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	177.80	172.47	PIPR79S	197.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	13.97	12.43	PIPR80S	28.13		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	304.80	271.27	PIPR81S	149.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	71.12	71.12	PIPR82S	105.76		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	83.82	79.63	PIPR83S	108.41		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	104.78	99.54	PIPR84S	114.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.70	132.72	PIPR85S	137.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.40	137.16	PIPR86S	114.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	260.35	182.25	PIPR87S	114.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	488.95	268.92	PIPR88S	122.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.20	188.98	PIPR89S	147.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	704.85	662.56	PIPR90S	185.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	952.50	904.88	PIPR91S	197.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1244.60	995.68	PIPR92S	188.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1485.90	891.54	PIPR93S	135.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	781.05	757.62	PIPR94S	181.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	476.25	404.81	PIPR95S	172.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	273.05	262.13	PIPR96S	191.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	22.23	20.45	PIPR97S	59.14		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	24.13	23.16	PIPR98S	64.08		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	36.83	34.99	PIPR99S	97.49		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	27.94	27.94	PIPR100S	78.99		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	26.67	26.67	PIPR101S	72.86		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	20.32	20.32	PIPR102S	50.73		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	26.67	26.67	PIPR103S	68.24		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.50	182.88	PIPR104S	146.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	109.86	96.67	PIPR105S	93.76		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.20	182.88	PIPR106S	128.86		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	209.55	190.69	PIPR107S	113.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	127.06	PIPR108S	101.01		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.10	148.59	PIPR109S	120.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	254.00	223.52	PIPR110S	137.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	311.15	283.15	PIPR111S	142.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.10	150.24	PIPR112S	106.74		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	920.75	644.53	PIPR113S	131.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1073.15	697.55	PIPR114S	116.5		Erickson et al. 1996a,b

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	<24 h	S,M,T,D	S	1003.30	752.48	PIPR115S	109.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	933.45	653.42	PIPR116S	123.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	742.95	646.37	PIPR117S	129.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1879.60	939.80	PIPR118S	124.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	266.70	253.37	PIPR119S	176.1		Erickson et al. 1996a,b
	---	F,M,T	S	114.00	---	PIPR120F	17.99		Lind et al. Manuscript (1978)
	---	F,M,T	S	121.00	---	PIPR121F	19.70		Lind et al. Manuscript (1978)
	---	F,M,T	S	88.50	---	PIPR122F	13.27		Lind et al. Manuscript (1978)
	---	F,M,T	S	436.00	---	PIPR123F	78.50		Lind et al. Manuscript (1978)
	---	F,M,T	S	516.00	---	PIPR124F	50.09		Lind et al. Manuscript (1978)
	---	F,M,T	S	1586.00	---	PIPR125F	66.49		Lind et al. Manuscript (1978)
	---	F,M,T	S	1129.00	---	PIPR126F	73.03		Lind et al. Manuscript (1978)
	---	F,M,T	S	550.00	---	PIPR127F	42.76		Lind et al. Manuscript (1978)
	---	F,M,T	S	1001.00	---	PIPR128F	34.39		Lind et al. Manuscript (1978)
	30 d, 0.15 g	F,M,T,D	N	96.00	88.32	PIPR129F	39.58		Spehar and Fiandt 1986
	<24 h	F,M,T,D	S	31.75	27.94	PIPR130F	8.69		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	117.48	105.73	PIPR131F	37.88		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	48.26	40.06	PIPR132F	10.80		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	73.03	64.26	PIPR133F	22.19		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	59.06	49.02	PIPR134F	20.32		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	78.74	67.72	PIPR135F	18.51		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	22.23	18.67	PIPR136F	13.61		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	6.99	6.15	PIPR137F	10.94		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	22.23	20.45	PIPR138F	17.70		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	107.32	93.36	PIPR139F	67.09		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	292.10	245.36	PIPR140F	17.75		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	81.28	72.34	PIPR141F	41.16		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	298.45	229.81	PIPR142F	16.18		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	241.30	195.45	PIPR143F	24.40		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	133.35	109.35	PIPR144F	21.07		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	93.98	78.00	PIPR145F	50.83		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	67.95	45.52	PIPR146F	23.18		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	4.76	4.38	PIPR147F	40.09		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	13.97	12.43	PIPR148F	45.37		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	29.85	26.86	PIPR149F	59.43		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	59.69	51.33	PIPR150F	58.84		Erickson et al. 1996a,b
Northern squawfish, <i>Ptychocheilus oregon</i>	larval, 0.32 g	S,M,T	S	380	---	PTLU01S	88.44	132.2	Dwyer et al. 1995
	larval, 0.34 g	S,M,T	S	480	---	PTLU02S	197.6		Dwyer et al. 1995

Table 1. Acute Toxicity of Copper to Freshwater Animals

Species ^a	Organism Age, Size, or Lifestage	Method ^b	Chemical ^c	Reported LC50 or EC50 (total µg/L) ^d	Reported LC50 or EC50 (Diss. µg/L) ^e	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L) ^f	Species Mean Acute Value (µg/L) ^g	Reference
Northern squawfish, <i>Ptychocheilus oregon</i>	5.0 cm, 1.33 g 7.2 cm, 3.69 g	F,M,T F,M,T	C C	23 18	---	PTOR01F PTOR02F	17.02 12.54	14.61	Andros and Garton 1980 Andros and Garton 1980
Razorback sucker, <i>Xyrauchen texanus</i>	larval, 0.31 g larval, 0.32 g	S,M,T S,M,T	S S	220 340	---	XYTE01S XYTE02S	63.78 97.0	78.66	Dwyer et al. 1995 Dwyer et al. 1995
Gila topminnow, <i>Poeciliopsis</i>	2.72 cm, 0.219 g	S,M,T	S	160	---	POAC01S	56.15	56.15	Dwyer et al. 1999
Bluegill, <i>Lepomis macrochirus</i>	3.58 cm, 0.63 g 12 cm, 35 g 2.8-6.8 cm 3.58 cm, 0.63 g	R,M,D F,M,T F,M,T F,M,D	C S C C	- 1100 1000 -	2200 ---	LEMA01R LEMA02F LEMA03F LEMA04F	2202 2305 4200 1163	2231	Blaylock et al. 1985 Benoit 1975 Cairns et al. 1981 Blaylock et al. 1985
Fantail darter, <i>Etheostoma flabellare</i>	3.7 cm 3.7 cm 3.7 cm 3.7 cm	S,M,T S,M,T S,M,T S,M,T	S S S S	330 341 373 392	---	ETFL01S ETFL02S ETFL03S ETFL04S	117.7 121.1 122.8 136.6	124.3	Lydy and Wissing 1988 Lydy and Wissing 1988 Lydy and Wissing 1988 Lydy and Wissing 1988
Greenthroat darter, <i>Etheostoma</i>	2.26 cm, 0.133 g	S,M,T	S	260	---	ETLE01S	82.80	82.80	Dwyer et al. 1999
Johnny darter, <i>Etheostoma nigrum</i>	3.9 cm 3.9 cm 3.9 cm 3.9 cm	S,M,T S,M,T S,M,T S,M,T	S S S S	493 483 602 548	---	ETNI01S ETNI02S ETNI03S ETNI04S	167.3 164.2 200.1 183.9	178.3	Lydy and Wissing 1988 Lydy and Wissing 1988 Lydy and Wissing 1988 Lydy and Wissing 1988
Fountain darter, <i>Etheostoma rubrum</i>	2.02 cm, 0.062 g	S,M,T	S	60	---	ETRU01S	22.74	22.74	Dwyer et al. 1999
Boreal toad, <i>Bufo boreas</i>	tadpole, 0.012 g	S,M,T	S	120	---	BUBO01S	47.49	47.49	Dwyer et al. 1999

^a Species appear in order taxonomically, with invertebrates listed first, fish, and an amphibian listed last. Species within each genus are ordered alphabetically. Within each species, tests are ordered by test method (static, renewal, flow-through) and date.

^b S = static, R = renewal, F = flow-through, U = unmeasured, M = measured, T = exposure concentrations were measured as total copper, D = exposure concentrations were measured as dissolved copper.

^c S = copper sulfate, N = copper nitrate, C = copper chloride.

^d Values in this column are total copper LC50 or EC50 values as reported by the author.

^e Values in this column are dissolved copper LC50 or EC50 values either reported by the author or if the author did not report a dissolved value then a conversion factor (CF) was applied to the total copper LC50 to estimate dissolved copper values.

Normalization Chemistry												
Temp	pH	Diss Cu	DOC	%HA	Ca	Mg	Na	K	SO ₄	Cl	Alkalinity	S
Deg C 20.00	ug/L 7.5	mg/L 1.00	mg/L 0.5	10.0	mg/L 14.0	mg/L 12.1	mg/L 26.3	mg/L 2.1	mg/L 81.4	mg/L 1.9	mg/L 65.0	mg/L 0.0003

^g Underlined LC50s or EC50s not used to derive SMAV because considered extreme value.

* Table updated as of March 2, 2007